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ABSTRACT

A study is reported relevant to the relationship between first words learned by children and gestural symbolization under a variety of contextual conditions. It is part of a larger longitudinal study of 32 children at 10, 13, 20, and 27 months of age. The children were seen in three standardized situations for eliciting gestural and vocal symbols: (1) a set of three complex scenarios including an eating script, a drinking script, and a bed script: (2) a type of multiple choice test for language comprehension: and (3) presentation of single schemes with single objects. Analysis of the data from these measures indicates that as the amount of non-symbolic contextual support for a symbolic gesture decreases, the number and strength of correlations with language production increases. The findings also bear out the predictions of some previous research, namely, that the kind of gestural symbol which is most like vocal naming is a symbol that is relatively independent of its object or referent. (AMH)

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THE EMERGENCE OF SYMBOLS IN LANGUAGE AND ACTION:

SIMILARITIES AND DIFFERENCES

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Some time around the end of the first year, normal children make the crucial discovery that things have names. Although naming is in some sense the quintessential linguistic act, Piaget (1962) and Werner and Kaplan (1963) have argued that it is just one manifestation of a more general symbolic/representational capacity, reflected in such diverse domains as memory for objects, imagery, problem-solving, imitation and symbolic play. Some recent correlational studies provide only partial support for this hypothesis. Some areas of non-linguistic development do indeed correlate with the emergence of meaningful speech, in particular symbolic play, imitation and some limited aspects of tool use in problem-solving (Bates, et al., 1979; Nicholich, 1978; Snyder, 1978; Curcio,1977). However, several other central areas of sensorimotor development do not seem to correlate with language at all, at least in the earliest stages of one word speech. These include spatial relations (Bates et al., 1979) and object permanence (Bates et al., 1979, Corrigan, 1978, Snyder, 1978). These correlational patterns suggest a revision of the Piaget-Werner hypothesis, in the direction of a "domain specific" or "local homology" model (e.g. Fischer,1979; Uzgiris and Hunt, 1975; Bates et al., 1979; Miller, Chapman and Bedrosian, 1977) in which tasks are correlated in limited ways, at particular points in time, when they share specific (albeit hypothetical) underlying structures.

The strongest evidence for such domain-specific relations to early naming is in the area that Piagetians refer to as symbolic play (Lézine, 1973; Inhelder, Lézine, Sinclair, and Stambak, 1971), also called "gestural depiction" by Werner and Kaplan. Examples include such gestures as holding a toy telephone to the ear, stirring with a spoon, pushing a toy car back and forth on its wheels. In contrast with earlier communicative gestures like giving, showing and pointing (Bates et al., 1977), these gestural symbols are conventional acts that could only have been derived by imitating adults in the child's culture. It has been argued that these gestures are functionally related to their objects, i.e., indices, and hence quite unlike the arbitrary social conventions of vocal naming. However, there is good reason to believe that such gestural conventions are quite arbitrary from the point of view of the one-year-old child, who often has no idea what the gestures are supposed to do.

For example, these are typically very brief and incomplete (lasting an average of 2-3 seconds), the actual function often seems irrelevant (e.g. an empty cup may be used for "drinking," or a child may try to sit in a chair that is only 2 inches tall), and the schemes are sometimes applied to objects that are only marginally like the original model (e.g., putting a spoon to the ear and saying "hello"). Several proponents of the Genevan school, particularly Sinclair, have insisted that gestural schemes should only be called "symbolic" when they are finally extended to inappropriate objects, as in the spoon/telephone example, and not to instances in which the child carries out a delayed imitation with a correct, prototypic object. However, regardless of what we call these behaviors, it is clear that they function very much like naming at 13 months of age. That is, the child apparently uses them to identify, recognize, categorize, in some sense "name" an object, event, or class of objects and events.

Some of the strongest evidence that gestural symbols are in fact a type of naming comes from Bates et al. (1979) and Volterra et al. (1979), comparing the gestural and vocal repertoires of 25 Italian and American infants studied between 9 and 13 months of age. Their findings can be summarized as follows:

(1) V-symbols (vocal) and G-symbols (gestural) emerge around the same time, and are correlated across the sample in frequency of use, rate of acquisition, and number of different schemes observed by the Experimenter and reported by the mother.

(2) Patterns of correlations with other measures are quite similar for V- and G-symbols. Both correlate with aspects of tool use and imitation, while neither correlates with spatial relations or object permanence.

(3) Both kinds of symbols are initially acquired with prototypic objects, in highly stereotypic routines or scripts. At roughly parallel rates, they gradually "decontextualize" or extend out to a wider and more flexible range of objects and events.

(4) There is tremendous overlap in content for both G- and V-symbols, when "vocabularies" are compiled across the whole sample. There are words for such concerns as eating, dressing, play with vehicles, telephones, games of exchange and peekaboo, sleeping, bathing, and doll play. The repertoires of conventional gestures involve precisely the same set of concerns: eating, dressing, telephones, exchange games, etc. In short, the two types of symbols refer to, name, or in some sense "mean" the same things.

The Bates et al. and Volterra et al. findings demonstrate strong similarities between G- and V-symbols, but provide no information about possible differences. As noted earlier, tests of the Piaget-Werner hypothesis have forced researchers to reformulate the "general symbolic

capacity" in terms of specific structural relations that vary with tasks and eliciting conditions. It should not surprise us if the same lesson applies to different aspects of naming. The above findings were collected in naturalistic situations, with no control over the particular conditions that elicited either gestural or vocal conventions. There are several reasons why we might expect modality differences to emerge if those conditions were controlled.

First of all, for a hearing child the surrounding community encourages a greater reliance on V-symbols for communication. Indeed, one important aspect of the G-symbols produced by 13 month olds is that they are rarely used in communication. Instead, they tend to occur in solitary play with objects. Even when these gestures do occur during adult-child interaction, the communicative aspect of object play is generally restricted to showing and pointing. We have, for example, never witnessed a 13-month old child requesting something to drink by executing a pantomime of drinking. Such a clear difference in function must surely affect the nature of vocal vs. gestural symbols at some point in development.

Secondly, there are some important processing differences between the acoustic-articulatory channel of speech and the visual-manual channel in which G-symbols are expressed. Klima and Bellugi (1979) have discussed some of these differences as they pertain to comparisons of speech and American Sign Language. For example,

(1) The visual channel permits greater simultaneity in the expression of complex meanings, while the acoustic-articulatory channel requires sequential expression of individual meaning elements.

(2) There are important differences in memory span and speed of processing in the auditory vs. the visual modality.

(3) The visual channel has a greater potential for pantomime, leading to greater iconicity or transparency between sign and meaning--at least for signs that have just been introduced into the language[1] (c.f. Frishberg, 1979).

In addition to the modality differences relevant to speech vs. ASL, the particular gestural conventions acquired by our normal hearing subjects involve yet another important modality difference. Unlike the signs for objects in ASL, the G-symbols used by 13-month-olds typically involve actions directly on the associated object. This is of course not true for vocal symbols. It is worth noting in this regard that very young children acquiring ASL will often try to sign a name directly on the referent person or object, violating rules governing position in signing space (Bellugi, personal communication). It is as if the symbolic bond is easier to maintain or understand with a direct touch.

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[1] We suspect that such iconicity plays only a minor role in the acquisition of G-symbols by 1-year-olds. For a full presentation of this rather complex argument, see Bates, Chap. 2, 1979.

All of these modality differences lead us to propose a more detailed look at symbol development, controlling the eliciting conditions for symbol use. We have tried to operationalize the elusive notion of "context" by varying the number and type of object referents for G- and V-symbols, and by examining the way that these object/gesture/vocalization triads work within complex scripts vs. single object/scheme combinations.

The study to be reported here is part of a larger longitudinal study of 32 children at 10, 13, 20 and 27 months of age. We will present data from the 13-month session only, relevant to the relationship between first words and gestural symbolization under a variety of contextual conditions.

METHOD

For some of the measures of interest here, there were missing data on 3 infants from the full sample. Hence the results below range from N=29 to N=32. All of the subjects were normal, healthy infants from middle class families in Boulder, Colorado. The mean age was 57 weeks, ranging from 54 to 59.

Infants were visited twice in the home, and came to the University of Colorado laboratories with their mothers for a third session. Two of the three standardized situations to be discussed here were administered in the laboratory while a third was administered in the second home visit. On the first visit, 1-2 hour interviews were conducted with the mothers concerning the child's comprehension and production of words, with extensive probes for information about the contexts in which the words were used. The interview was based on a 100-item word and phrase checklist compiled from our own previous research and relevant reports by other investigators. The transcribed interviews were coded independently by two investigators. Both comprehension and production items were divided into common nouns, proper nouns, and a heterogeneous class of predicates including verbs, adjectives, functors like "more" and "no", and verbal routines like "bye bye." These items were then classified according to the mother's contextual information into "context bound" uses (e.g. "ball" applied only to a particular ball, or used only at a certain point in a throwing game) vs. "context-flexible" uses (e.g. "ball" used to name two or more different referents, in more than one type of situation). This context coding system yielded an average of 82% agreement for a given corpus. Discrepant codings were resolved by the two raters in joint meetings.

The children were seen in three standardized situations for eliciting G- and V-symbols, situations designed to vary the number and kinds of objects and the complexity of the script.

Situation$_1$ is a set of three complex scenarios adapted from Wolf and Gardner (personal communication). The three scenes include an eating script (with plate scraping, eating with gusto and appropriate noises,

and wiping the mouth), a drinking script (with pouring from a pitcher into a cup, spilling the "juice" and wiping it up, pouring again and drinking), and a bed script (patting a "sleepy" doll, putting it into bed, covering it with a blanket and kissing it goodnight). Each scenario was preceded by a brief period in which the child was given the props and observed in spontaneous play with them. Then each script was modelled four times: with a realistic spoon (or cup, or doll), then with a tiny version of the same object, then with an abstract or schematic spoon (or cup, or doll), and finally with the "zero" or "placeholder" object, a plain wooden cylinder that served as spoon, cup and doll in the three respective scripts. After each presentation (totalling 12 trials, four for each scenario) the child was given the props and observed as long as he remained minutely involved with the toys (usually about 2-3 minutes). His performance with the toys was scored for production of both vocal and gestural conventions, including ad libs as well as modelled acts.

In this study, the 12 trials were presented in a fixed order: drinking, eating and bedtime, with a progression from realistic to zero objects within each. In a separate study of 30 infants, Shore (in preparation) randomized trials and scenarios and applied the same codings for vocal and gestural symbols. For both the fixed and the random orders, children perform at similar levels in the three featured object trials (realistic, tiny and abstract), but at significantly lower levels for the placeholder trials. Also, in both studies performance is correlated across the featured object trials, but uncorrelated with gestural production on the placeholder trials. Based on Shore's findings for the complex scenario situation in this analysis we combined scores for the 9 featured object trials. There are, then, 3 vocal and 3 gestural scores for each child: spontaneous (free play with the props prior to each scenario), featured object trials, and placeholder trials.

Situation$_2$ is a type of multiple choice test for language comprehension, reported in more detail elsewhere (Bates, Bretherton, Shore and Karpen, 1979). The child is seated in front of a clear plastic box with three wells. On each of 16 trials, three common objects are placed in the wells, drawn from a set of eight including a bottle, cup, spoon, doll, teddy bear, shoe, telephone and car. On 8 of the trials the objects are realistic and perceptually detailed toys. On the other 8 trials, the objects are abstract versions of the same toys, preserving just a couple of essential features. Realistic and abstract trials were alternated and presented in one of two orders such that the goal object appeared in all three compartments about one third of the time and a realistic goal object was not followed by the same abstract goal object. The child is asked to "Get the _____," with the name repeated until he has made either a correct or an incorrect object choice. After selecting a toy, the child was observed for approximately 30 seconds during which his behavior was coded for production of either vocal or gestural conventions. For example, saying "vroom" or "car" would be classified as a V-symbol, while rolling the car back and forth on the table would be classified as a G-symbol. As reported by Bates, Bretherton, Shore and Karpen, children

in this multiple choice test produced an average of 2.7 G-symbols and 1.5 V-symbols on abstract trials, vs. 4.3 G-symbols and 2.0 V-symbols on realistic trials. The measures used in the analyses reported here include three comprehension measures (total correct object choices, and total correct on abstract vs. realistic trials), and two production measures (total number of trials with G-symbols and total number of trials with V-symbols).

Situation 3 is adapted from Killen and Uzgiris (1978). In contrast with the complex scenarios of Situation 1, this task involves presentation of single schemes with single objects. On each of 8 trials, the child is first offered an object and observed in his spontaneous use of it (both G- and V-symbols). Then, on each trial, the Experimenter silently models one simple act. On four of the trials, the gestural convention matches the object: brushing with a brush, hopping a toy kitten, drinking from a cup, rolling a toy car. On the other four trials, the object and gesture are mismatched: brushing the hair with a kitten, "driving" the cup back and forth on the floor, drinking from a toy car, hopping the hairbrush across the floor. Four scores were derived for each child: total spontaneous naming, total spontaneous gesturing (before modelling), total elicited gestures on appropriate trials and on inappropriate trials.

RESULTS AND DISCUSSION

The vocal and gestural measures taken from the three laboratory situations were entered into Pearson Product Moment correlations (two-tailed tests for significance) with the language measures from the maternal interview. We will first present the relationships between language in the laboratory and language in the interview. These correlations are of little theoretical interest, but do provide important cross-validation for our use of the more detailed interview measures as "targets." Then we will turn to the relationships between our observations of gestural symbols, and the target measures from the language interview.

Language X Language: evidence for validity of measures

First of all, the relationship between comprehension and production in the maternal interview was positive but below significance (.30, $p < .10$, two-tailed). Children showed three kinds of patterns: high production/high comprehension, low production/low comprehension, and low production/high comprehension. The only pattern that did not occur was high production/low comprehension. In other words, with this mode of assessment language production and language comprehension are relatively independent. This result is quite useful, since it permits us to differentiate the respective relationships of comprehension and production to aspects of gestural symbolization.

Second, the laboratory language measures generally validate our use of the maternal interview data. As summarized in Table 1A the laboratory comprehension measures (correct object choice in the multiple choice test) correlate more often with language comprehension in the interview than with production. On the other hand, the various vocal production measures in the laboratory are more clearly related to interview production than

comprehension. In other words, the relative independence of comprehension and production in the language interview is reflected in the laboratory measures as well.

The comprehension data also provide support for the common noun/proper noun predicate division. Proper nouns are excluded from Table 1A, for several reasons. First of all, there were far fewer of these reported overall than either common nouns or predicates. Hence the measure may be somewhat unstable. Secondly, the correlations between proper nouns and the other measures are generally negative. It is likely that the child's repertoire of proper names reflects more about birth order, social environment, and babysitter arrangements than language per se. The question warrants investigation, but will not be discussed further here. By contrast, the common noun/predicate distinction yields a reasonable set of relationships. As noted in Table 1A comprehension of object names in the multiple choice situation is correlated significantly with the maternal report of common noun comprehension, but not with the reported number of predicates (.63, $p < .005$). In other words, the 2 measures of object name comprehension go together.

Finally, the comprehension findings attest to the validity of the codings into context-bound and context-flexible usage. Object choice on the realistic trials is significantly correlated with both context-bound and context-flexible comprehension of common nouns (.44 and .43 respectively). However, correct choice on the abstract trials correlates only with context-flexible comprehension (.57, $p < .005$). In other words, children whose mothers report a "decontextualized" understanding of object names are also able to match names to minimal objects in a laboratory task.

The language production data are much less specific. Except for vocal production in the complex scenario, all of the laboratory measures of speech correlate with both predicates and common nouns. This is not surprising, since the set of vocalizations observed in the laboratory was too small to permit meaningful division into names and predicate terms. In any case, production in the interview predicts production in the laboratory.

In sum, the correlations presented in Table 1A provide validity for the maternal interview measures of language, and justify our use of those measures as target variables for comparison with the gestural data. Comprehension and production seem to be relatively independent, the distinction between common nouns and predicates is a meaningful one, and the coding of items for contextual dependence does seem to have something to do with contextual flexibility in laboratory situations.

Language X Gestural Symbols

Table 1B summarizes the correlations between scores for gestural symbols produced in the three standardized tasks, and the various language measures from the maternal interview.

Note first that we have another version of the comprehension/production split reflected in the relationships with G-symbols. The gestural measures

TABLE 1 - CORRELATIONS OF LANGUAGE MEASURES FROM THE MATERNAL INTERVIEW WITH VOCAL SYMBOLS (TABLE 1A) AND GESTURAL SYMBOLS (TABLE 1B)

Total - out.

	COMPREHENSION INTERVIEW							PRODUCTION INTERVIEW						
	[1]TOTAL COMP.	PREDICATE TERMS Context-Bound	Context-Flexible	[2]Total	COMMON NOUNS Context-Bound	Context-Flexible	[2]Total	[1]TOTAL PROD.	PREDICATE TERMS Context-Bound	Context-Flexible	[2]Total	COMMON NOUNS Context-Bound	Context-Flexible	[2]Total
MEANS	46.13	15.8	6.2	22	9.8	5.2	17.5	10.86	2.6	1.5	4.8	1.2	2.1	3.9
LABORATORY VARIABLES														
Vocal Symbols														
Object Choice in Language Comprehension														
-Realistic	~	-	-	-	.44	.43	.46	.36	.41	*.47	.46	-	.39	~
-Abstract	~	-	-	-	-	**.57	.45	-	-	-	-	-	-	-
-Total Correct	-	-	-	-	.45	**.63	**.57	-	.39	-	~	~	-	-
Spontaneous Voc. in Object Choice Task	-	-	.42	-	-	-	-	*.48	-	.47	.41	-	-	.43
Spontaneous Voc. in Single Object Task (before modelling)	-	-	-	-	-	-	-	~	-	.38	-	-	*.49	.42
Spontaneous Voc. in Complex Scenario (before modelling)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elicited Voc. in Complex Scenario														
-Featured Objects	-	-	-	-	-	-	-	**.54	-	**.56	*.50	**.56	-	*.50
-"Zero" Objects	-	-	.35	-	-	-	-	.38	-	.34	-	*.48	-	.37
Gestural Symbols														
Spontaneous Schemes in Object Choice Task	-	-	-	-	-	.44	~	-	-	-	-	-	.44	-
Spontaneous Schemes in Single Object Task (before modelling)	-	-	-	-	-	-	-	.36	-	-	-	.36	.41	.40
Spontaneous Schemes in Complex Scenario (Before modelling)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Elicited Schemes in Single Object Task														
-appropriate	-	-	-	-	-	-	-	.36	-	-	-	-	-	.38
-inappropriate	-	-	-	-	-	-	-	**.55	.43	*.48	*.49	.44	.36	**.54
Elicited Schemes in Complex Scenario														
-featured objects	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-"zero" object	*.50	-	-	.35	.44	**.54	**.55	-	-	-	-	-	-	-

[1]Includes count of proper names [2]Includes items not classifiable by context

~ = marginal ($p < .10$) - = non-significant
* = $p < .01$
** = $p < .005$
otherwise $p < .05$

are all, of course, symbol productions. There are no direct measures here of the child's comprehension of gestural conventions, although the acts modelled by the adult must obviously be comprehended or processed in some way by the child if he is to imitate them. Nevertheless, the gestural measures derived here seem to correlate more with language production than with comprehension. Indeed, with one interesting exception, the relationships between G-symbols in the laboratory and comprehension in the interview are entirely random. The single exception is the score for elicited gestural symbols with the zero or placeholder object, in the complex scenarios. This pattern was certainly not predicted, and hence should be interpreted with caution. However, the relationships are strong and consistent enough to merit consideration. First of all, placeholder gestures correlate with comprehension of common nouns but not with comprehension of predicates. In other words, the two kinds of measures are in some sense "about" objects. Furthermore, the relationship with context-flexible common nouns is .54, significant beyond $p < .005$. The correlations with context-bound nouns is much weaker (.44. $p < .0$). Finally, placeholder gestures also correlate with language comprehension in the laboratory, i.e., a correlation of .53, $p < .003$, with comprehension of object names in the abstract trials of the multiple choice test.

There is at least a tentative explanation for the relationship between placeholder gestures and comprehension. The complex scenarios offer considerable contextual support for the child to accept and treat the plain wooden cylinder as a spoon, a cup or a doll. There are several related props for each script, which remain constant while the target object changes (e.g., there is a realistic bed and blanket for the child to use with the placeholder "doll"). Also, the Experimenter is repeatedly telling the child, with both linguistic and gestural conventions, that the placeholder object is in fact something else (e.g., "Poor baby is so sleepy, let's put him to bed . . . "). In a sense, then, the child in this situation is receiving a "fill in the blank" test, a minimal gestural production following considerable comprehension of the complete scenario. In short, the production of a placeholder gesture says more about the child's comprehension up to that point than about symbol production in general. From this perspective, the analogous items with featured dolls, cups and spoons provide total contextual support--not even leaving a blank to be filled. And indeed, gestural production with featured objects, in the complex scenario, does not correlate with either comprehension or production of language. Variations in performance within such contextually detailed tasks may not reflect anything of cognitive interest, at least at this age level.

Let us turn now to the correlations between language production and production of gestural symbols. Figure 1 is a schematic representation of the relationships detailed in Table 1B. From left to right, the chart reflects a decrease in the contextual support available to the child for production of a symbolic gesture. The general pattern can be summarized as follows: As the amount of non-symbolic contextual support for a symbolic gesture decreases, the number and strength of correlations with language production increases. This conclusion is supported by the following contrasts.

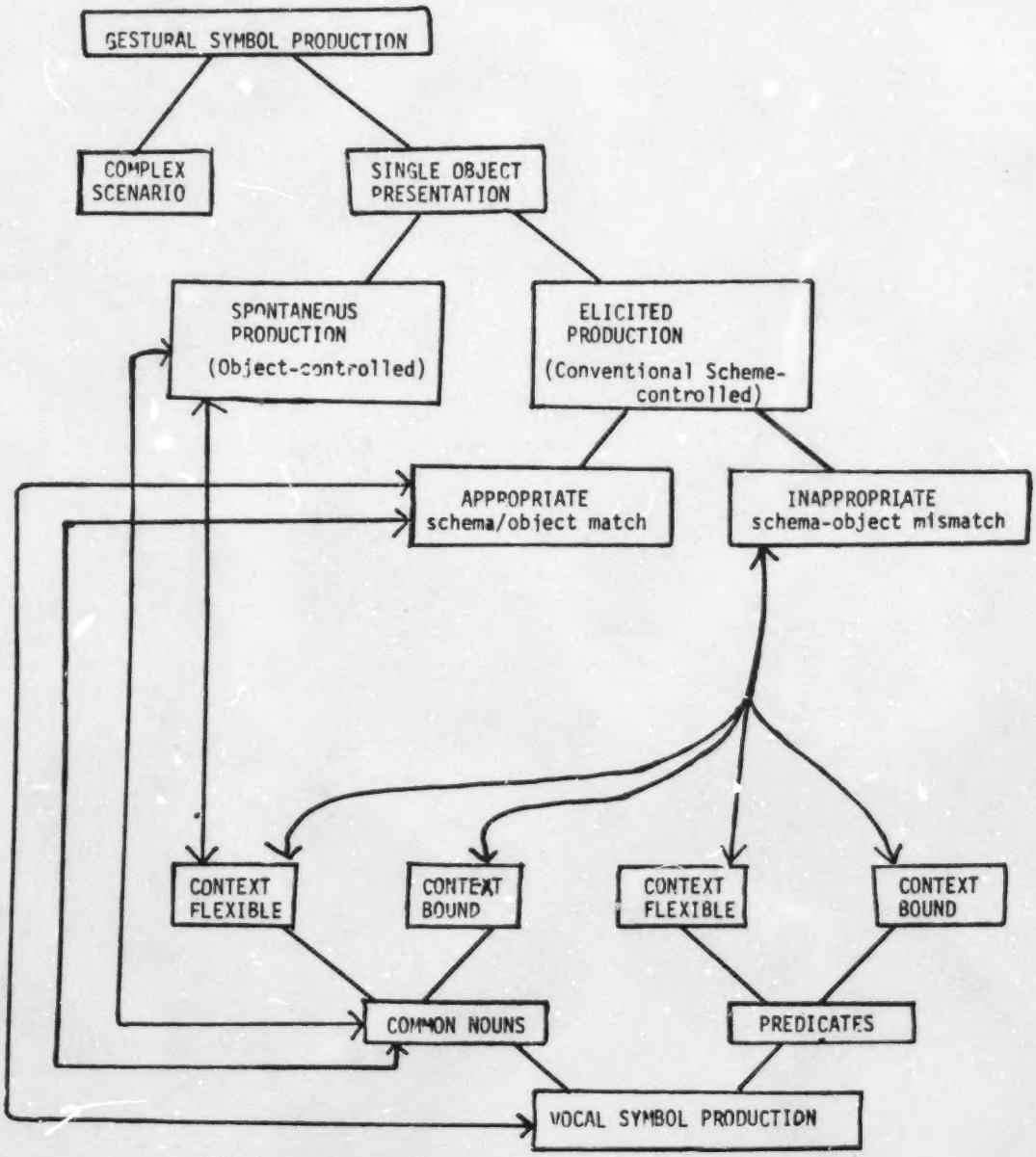

Figure 1: Relationships between production of gestural symbols (laboratory tasks) and production of vocal symbols (as assessed by maternal interview)

(1) G-symbols in complex scenarios (with multiple props, vocalization and gestures by E) do not correlate with language production at all. G-symbols with simpler single - object situations do predict language.

(2) Within the single object tasks, there is also a contrast between spontaneous and elicited production. Spontaneous productions, i.e., prior to modelling by E, are controlled or supported solely by the familiar objects. Elicited productions, instead, are controlled or supported by the Experimenter's conventional schemes. In this light, it is interesting that spontaneous or object-controlled G-symbols correlate only with production of common nouns, and not with production of predicates. In short, these gestures are like common nouns in that they are "about" objects.

(3) Within the measures of elicited gestural production, we also find a contrast between appropriate and inappropriate scheme/object combinations. With the appropriate models, both the object and the adult scheme offer contextual support for the child's productions. Performance on these items correlates with common nouns but not with predicates, much like spontaneous productions. With the inappropriate models, object support and scheme support are in competition. For the child to receive a production score, he must overcome his knowledge of the referent object (e.g., the kitty) and carry out the competing gesture (e.g., brushing the hair). In fact, performance on the inappropriate items is the strongest gestural predictor of language in the whole battery, correlating at .54 ($p < .005$) with common nouns and at .49 ($p < .01$) with predicates.

To summarize, the correlations between gestural and vocal symbolization increase as we strip the supporting context of information from referent objects and their usual scripts. The kind of gestural symbol which is most "like" vocal naming is a symbol that is relatively independent or "distanced" from its object or referent--precisely what Werner and Kaplan (1963) have predicted.

An alternative interpretation might be that the left to right order in Figure 1 reflects nothing more than a linear increase in task difficulty. Hence the increasing correlations with language may be based solely on general intelligence, maturation or problem solving ability. However, this interpretation cannot account in any systematic way for the clear differences between comprehension and production. Performance on the inappropriate gesture-object combinations is not correlated significantly with language comprehension. There is no a priori reason why such a comprehension-production difference should occur for tasks that reflect IQ or general maturation.

In listing some differences between the vocal and manual modalities, we mentioned the fact that gestures can directly participate in or touch their referents while vocalizations cannot, at least not in the same sense. It is particularly interesting in this regard that G-symbols with the wrong objects correlate with vocal naming--as though we had found a way to equate the two kinds of symbols along the dimension of object contact.

In conclusion, our data suggest that there is a systematic relationship between vocal and gestural symbols which increases as the symbols become decontextualized in use. These findings provide further support for the local homology model, underscoring the domain-specificity of the relationship between language and cognition. In light of these findings, we are proposing further, more detailed, investigations of the role of object and script as contextual variables in the development of vocal and gestural symbols.

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